THURSDAY, NOVEMBER 21, 1889.

ROCK METAMORPHISM.

Chemical and Physical Studies in the Metamorphism of Rocks, based on the Thesis written for the D.Sc. Degree in the University of London, 1888. By the Rev. A. Irving, D.Sc.Lond., B.A., F.G.S. (London: Longmans, Green, and Co. 1889.)

DR. IRVING is well known as a writer on Bagshot beds. He appears in a new light as the propounder of theories dealing with the metamorphism of rocks. His ideas on this subject are classified under three heads: paramorphism, metatropy, and metataxis. *Paramorphism*, according to the author, includes those changes within in the rock-mass, involving changes in the chemical composition of the original minerals and the formation of new minerals; *metatropy* denotes changes in the physical character of rock-masses; and *metataxis*, mechanical changes, such as the development of cleavage. Changes brought about by the introduction of a new, or the removal of an old mineral (*e.g.* dolomitization) are treated under the head of *hyperphoric change*.

The author writes, he tells us, for those who are willing to look at geological phenomena "in the light of physical and chemical ideas." To all others his dissertation "must read rather like romance than sober science." He is not far wrong when he complains that the chemical side of geology has been neglected since the time of Bischof. The reason for this is to be found in the fact that geologists have been too busily engaged in reaping golden harvests in the demesnes of palæontology and stratigraphy to be much tempted by the allurements of chemical geology. With the resuscitation of petrology, however, the chemical constitution of rocks begins again to present problems of great interest and importance. But the author turns his chemical knowledge to bad account, we think, in applying it to the elaboration of sweeping generalizations. The views he puts forward may or may not be founded on sound chemical and physical axioms; but mere test-tube reactions will not suffice to explain the operations of Nature in the vast laboratory of the universe. The phenomena of metamorphism represent the net result of numerous and often antagonistic forces; and are not always simple reactions that may be expressed by a neat chemical equation.

Dr. Irving appears to be highly gifted with what he terms a "scientific imagination," the meteoric flights of which carry him far above the solid ground of fact or even justifiable theory. An instance of this faculty of the author's will be found on p. 66, where he seeks to explain the origin of foliation in Archæan rocks by the influence of "solar and lunar tides upon the non-consolidated magma in the Archæan and pre-Archæan (*sic*) stages of the earth's evolution." He proceeds:—

> "In such an unequally viscous mass there would be tension, contortion, and shearing to any extent during the tidal pulsations which the magma was suffering. . . . Portions already solidified, or nearly so, by segregation or otherwise, as time went on, would by their *vis inertiæ* present obstacles around which a fluxion structure would develop itself in the contiguous portions of the yielding magma, giving us perhaps in some cases 'Augengneiss.' The local tension of parts of the viscous lithosphere, especially near the crests of the waves, would imply stretching and consequent lowering of temperature, a circumstance favourable to local solidification. Who shall say that in the later and feebler struggles of this kind, as secular cooling went on, and the magma approached nearer and nearer to the conditions required for consolidation, some of these tidal waves may not have become *in situ* sufficiently rigid to outline some of the earliest lines of elevation?"

This is speculative enough in all conscience. On p. 29, the author discusses the influence of the salts dissolved in sea-water on submarine lava-flows, and suggests that serpentinization and the conversion of orthoclase into albite are the result of some process of "submarine paramorphism" effected by this agency. This, again, is pure hypothesis, there being no facts to support such a view.

There is a flavour of pedantry in the use of such expressions as "burnt hydrogen" for water (p. 64), or in such sentences as "orthoclase is probably the embryonic silicate of the terrestrial lithosphere" (p. 67). As the old lady is said to have remarked of the word Mesopotamia, there is something especially comforting and satisfying about this last sentence.

The pages bristle with "hard words," some of which are new to science. "Vitreosity" has an uncanny sound; "apophytic" is curious; and "dehydrodevitrification" is as inelegant as it is long. Indeed, so technical is the author's language that a clear understanding of his meaning involves constant reference to his definitions. Unfortunately such reference is rendered impracticable by the absence of an index.

The book bears witness to Dr. Irving's extensive acquaintance with foreign chemical and geological literature; references to foreign sources being abundant, sometimes superfluous. Indeed, there is more evidence of the author's acquaintance with literature than with facts derived from original observation. Good ideas may here and there be picked out; and the work no doubt contains some plausible explanations of geological phenomena; but of this we are assured, that the science of geology will not be advanced by those who spend their time in manufacturing wide-reaching generalizations or attractive theories in the library, but rather by those who are content to labour, with the hammer in the field, the microscope in the cabinet, and the balance in the laboratory at the ofttimes wearisome task of unravelling details.

This book may be placed in the same category as Sterry Hunt's "Chemical and Geological Essays." Such books can be recommended to those with a taste for speculation and rumination. To others they may be productive of mental confusion and headache.

HAND-BOOK OF DESCRIPTIVE AND PRACTICAL ASTRONOMY.

Hand-book of Descriptive and Practical Astronomy. By G. F. Chambers, F.R.A.S. Part I. The Sun, Planets, and Comets. (Oxford: Clarendon Press, 1889.)

THE avowed aim of the author of this work, since the publication of the first edition in 1861, has been to keep its pages up to date—to make it a sort of *vade mecum* to astronomers; and, regarded as a book en-

© 1889 Nature Publishing Group

deavouring to effect a compromise between purely elementary works on astronomy and advanced treatises, it is worthy of some praise. With the many remarkable developments of astronomical science during the last quarter of a century, the bulk of the original volume has been somewhat increased by additions, and it has now been decided henceforth to publish the work in three divisions, viz.—

(1) The sun, planets, and comets.
(2) Instruments and practical astronomy.
(3) The starry heavens.

The first division of the work is now before us, and viewed as a handy book of reference it has many commendable features; but all that could be said in its praise would be the reiteration of comments upon former editions.

The most important application of spectroscopy to astronomy is too well known to need any enlarging upon. It may be said to be almost entirely a creature of the last quarter of a century, but by far the greater amount of this spectroscopic work has been directed to the sun, whilst many new and important discoveries have been made in connection with it. In pre-spectroscopic times a spot on the sun was only that, and nothing more; and a solar prominence was a stupendous flame, the observation of which was only possible at eclipses. Nothing was known of their constitution; and, in fact, all we now know of the physical and chemical condition of the sun has been gained by spectroscopists. However, it is not necessary here to consider the enormous work that has been done in this direction, but it is our duty most emphatically to protest against a compilation such as the one before us—purporting to be a completely revised account of astronomical labours and advances, and yet rendering terribly conspicuous by its absence everything that relates to spectroscopy. It is like a book on locomotion leaving out all about railways because they were not prominent when the first edition was published. The pictorial representations of the corona, the solar prominences, the surface of the sun and the spots upon it, are well discussed in their respective sections, but no room has been given to an examination of their constitution by means of the spectroscope; and indeed, as far as this book is concerned, the whole work that has been done in connection with solar physics might have been left undone.

But these remarks apply not only to the chapters relating to the sun; those on the planets and comets respectively are in the same incomplete condition. Without the spectroscope, the source of luminosity of a comet was far beyond human ken, and its whole constitution was a matter of considerable doubt; with this instrument, however, much has been added to our knowledge—the comet's light has been analyzed, and the whole sequence of changes, as it goes from aphelion to perihelion and back again, is now understood. Yet the spectroscope might never have been turned to these bodies, or indeed utilized in any way, if the utility and importance of the work done were measured by the brief notice with which the author has seen fit to dispose of it, and the following may be said to be the reason for his grievous omissions:—

"The study of the sun has during the last few years taken a remarkable start, owing to the fact that, by the aid of the spectroscope, we have been enabled to obtain much new information about its physical constitution. The subject being, however, a physical rather than an astronomical one, and involving a great amount of optical and chemical details, it cannot conveniently be discussed at length in a purely astronomical treatise, though something will be said concerning it later on in the portion of this work dedicated to spectroscopic matters."

This explanation, however, only aggravates the fault. The importance of the work that has been done is assented to, but, instead of including that part of it relating to the sun in a chapter on that body, instead of considering the spectroscopy of comets as inseparable from a chapter devoted to their discussion, the author has relegated the whole work to an unpublished section devoted to astronomical instruments. Such an arrangement is undoubtedly wrong. A chapter on the sun must contain all that is known about that body, if it strives to be at all complete; similarly, a chapter on comets cannot approach completion unless their spectra are considered; thus this work cannot lead the general public to a just appreciation of the many advancements that have been made. The most elementary text-books rightly include the spectroscopic labours and discoveries, whereas this so-called hand-book, although aiming at being an historical account of the work that has been directed to the sun, planets, and comets respectively, leaves a vast array of facts out of consideration altogether.

There are a few minor faults, one of which is the figure relating to Foucault's pendulum experiment for determining the rotation of the earth. The author appears to have discarded the method of suspension adopted by Foucault, and the pendulum is sketched as if rigidly attached to a beam. The accompanying text also leaves this most important experimental detail out of consideration.

But apart from these points, the work is worthy of some commendation. An addition has been made to the chapter on comets, viz. a method of determining the elements of the orbit of a comet by a graphical process. The catalogue of comets whose orbits have been computed has also been brought up to date, and similar additions have been made to the chapters on periodic and remarkable comets. Doubtless the book will prove to be what it has been heretofore—a handy reference to some astronomical facts.

ELECTRICAL UNDERTAKINGS.

Proceedings of the National Electric Light Association at its Ninth Convention, 1889. Vol. VI. (Boston, Mass., U.S.: Press of *Modern Light and Heat*, 1889.)

WE have before us, in this volume, an account of the proceedings of the National Electric Light Association in the United States during the Convention held at Chicago on certain days in February 1889.

This body is one which, in the United States, has been brought into existence by the growing necessities and rapid expansion of the electric light and power industry. Probably its nearest English analogue is the Iron and Steel Institute. It is essentially a commercial association, and its aims may be said to be comprised within the limits of the exchange of practical information

© 1889 Nature Publishing Group